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DIRECTORATE OF
INTELLIGENCE

JCS review completed.

Intelligence Memorandum

POSSIBLE ALTERNATIVES TO THE ROLLING THUNDER PROGRAM

(The case where the Rolling Thunder Program is reinstituted under the March 1968 ground rules limiting attacks within 10 and 4 miles of the centers of Hanoi and Haiphong, respectively, and within the Chinese Buffer Zone.) (No. 10)

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CENTRAL INTELLIGENCE AGENCY
Directorate of Intelligence
22 May 1968

INTELLIGENCE MEMORANDUM

Possible Alternatives to the Rolling Thunder Program

(The case where the Rolling Thunder program is reinstituted under the March 1968 ground rules limiting attacks within 10 and 4 miles of the centers of Hanoi and Haiphong, respectively, and within the Chinese Buffer Zone.) (No. 10)

Summary

This memorandum examines the effects of a resumption of the Rolling Thunder program under the March 1968 ground rules. These rules permitted all of North Vietnam to be taken under attack except for targets within restricted bombing areas around Hanoi and Haiphong and within the Chinese Buffer Zone.

A return to the Rolling Thunder program as it existed before 31 March, particularly if undertaken during the second and third quarters of the year, when good weather predominates, could have the following major effects in the short-run:

1. Restoration of key industrial facilities, already accomplished or in process, would be quickly neutralized. Consequently, electric power output would again decline to 20 percent of national capacity, and cement and fertilizer production would cease.

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2. Coal exports, which in April 1968 had been brought up to 60 percent of pre-attack levels, would again decline, and prospects for exports of pig iron, cement, and apatite would be indefinitely postponed.

3. The restoration of through traffic on the principal rail and highway systems, which is being accomplished by the repair of key bridges, would be disrupted. The restored bridges and rail lines, enlarged truck parks, and open-storage stockpiles would constitute lucrative targets in the logistic supply system. An estimated 20,000 full-time North Vietnamese workers and 40,000 Chinese construction troops have been devoted to the restoration of this system since the partial cessation of bombing on 1 April.

4. It would again be possible to take under attack the major airfields in the north holding jet fighter aircraft. The in-country air Order of Battle now consists of 13 MIG 21's, 12 MIG 17's, and 4 IL-28 bombers.

5. There would be an immediate decline in the morale of the North Vietnamese population, since they would again be faced with the hardships and stress associated with the bombings. There would be increased local temporary shortages of food, more widespread shortages of consumer goods, and renewed requirements for extra work in repairs, civil defense, and other activities. Casualties, which amounted to approximately 36,000 killed and wounded in 1967 under the previous Rolling Thunder campaign, would again make a significant impact.

6. Since the resumption of a full-scale attack on the north would probably follow as a consequence of the complete impasse of peace negotiations and a continuation of a high

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level of infiltration of North Vietnamese forces into South Vietnam, presumably the Hanoi regime would have taken into account the consequences of its intransigence.

7. Although a large segment of world opinion would be critical of the United States for resuming the general bombing program, the extent of this criticism would depend on the circumstances under which the bombing was resumed. These criticisms would be particularly vocal if the bombings were expanded while the Paris talks were still going on, but proportionately less if they had broken off and heavy fighting continued in the south. The South Vietnamese would view the resumption as an indication of the resolve of the United States to continue the war.

In the long-run, the most significant effects of the bombing resumption would probably be on the labor force because between 500,000 and 600,000 workers would continue to be diverted either full-time or part-time from normal civilian occupations to civil and air defense tasks, to repair work, and to assistance in the movement of goods. There would also be a continuing drain of military supplies and equipment, not only material moving down the lines of communication to Laos and South Vietnam but also material associated with the air defense system. In combination, we believe these drains would have the following long-run effects:

1. Hanoi's allies would be required to maintain a high level of military and economic assistance in order to replace losses. This assistance would be largely uncompensated for because exports would be curtailed. Levels of supplies such as those flowing in through Haiphong and over the land lines from China during the first quarter of 1968, however, would appear to be adequate.

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2. After an initial period of disruption, Hanoi would be able to cope with the increased costs and difficulty of maintaining essential traffic movements and the current high-level flow of men and supplies to South Vietnam. In summary, the military situation would return to what it was in March, with North Vietnamese countermeasures and increased imports acting as an effective offset to the destruction caused by bombing.

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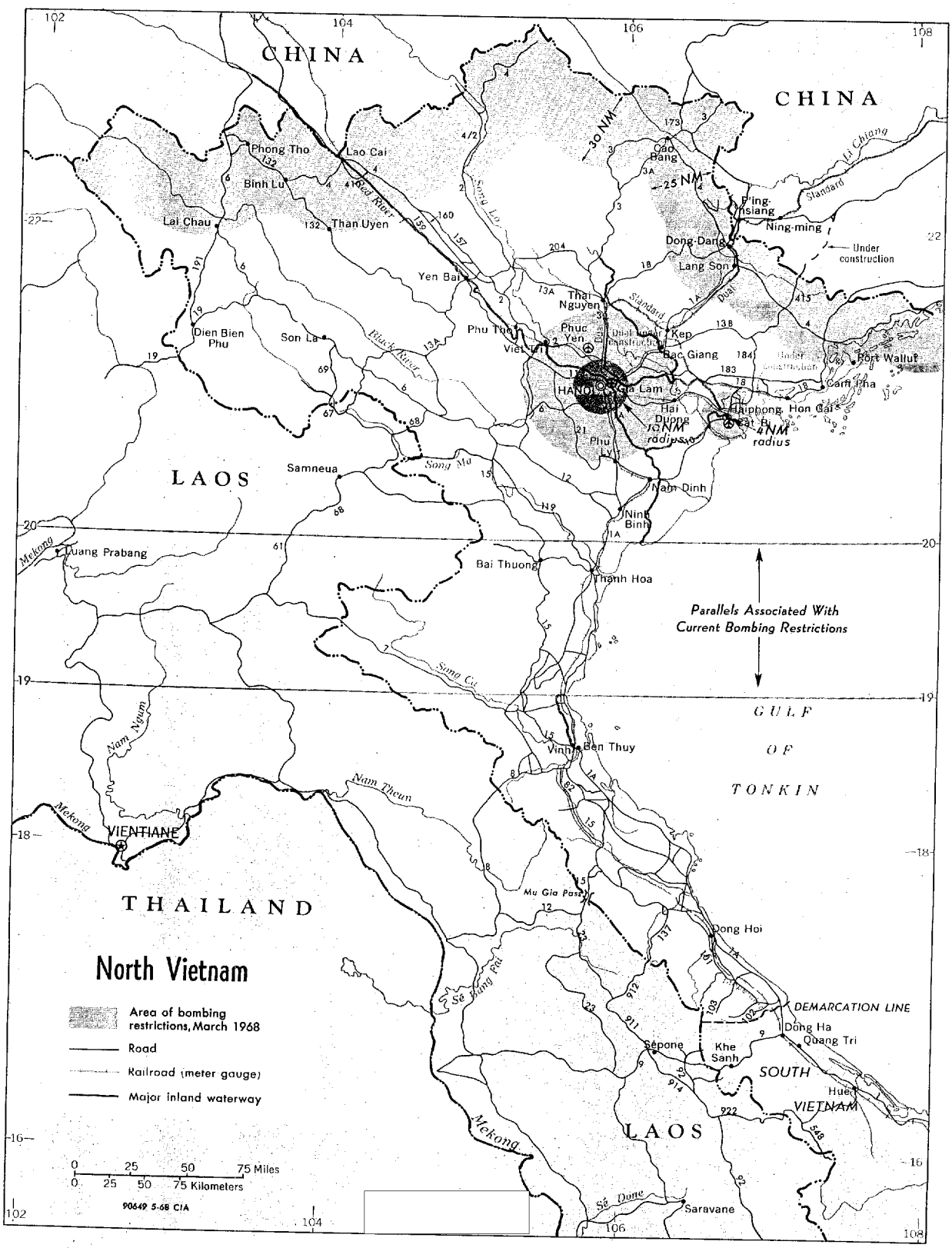

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I. Scale of Rolling Thunder Operations Through 31 March

The intensity and scope of Rolling Thunder air operations have increased each year since the air war began. During 1967, more than 191,000 sorties were flown over North Vietnam, almost as many as were flown in the two previous years combined, and a third of all the sorties flown over Southeast Asia. Approximately 60 percent of all sorties flown over North Vietnam were attack sorties. Ordnance delivered against targets in North Vietnam during 1967 was almost double that during 1966. The average tonnage of ordnance delivered per attack sortie has increased from 1.3 tons in 1965 to 2.3 tons in 1967, largely because of the increasing use of B-52 bombers in the southern part of North Vietnam. Total sorties, attack sorties, and tons of ordnance by US and Vietnamese Air Forces for the years of the Rolling Thunder program are shown in the following tabulation:

Year	Total Sorties a/	Attack Sorties	Tons of Ordnance
1965	55,560	25,880	34,300
1966	147,840	82,170	128,590
1967	191,250	107,070	247,520
Jan-Mar 1968	35,230	14,800	34,000 b/

a. Vietnamese Air Force sorties constitute less than one percent of total sorties.
b. Tonnage is estimated for March.

Unfavorable flying weather restricted the level of attack sorties flown in the first and fourth quarters of each year, as shown in the tabulation below. The unusually low number of sorties in the first quarter of 1968 resulted from bad flying weather, self-imposed bombing restrictions, and the diversion of a number of sorties to operations in the Khe Sanh area.

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Quarter	Average Number of Attack Sorties per Month			
	1965	1966	1967	1968
First	280	2,480	6,850	4,930
Second	1,870	5,900	10,590	
Third	3,560	11,450	10,700	
Fourth	2,930	7,560	7,540	

Most of the Rolling Thunder campaign has been directed against targets in Route Packages I, II, and III. Two-thirds of all attack sorties were in these Route Packages in 1967 and about 75 percent in the first quarter of 1968. Attacks against targets in Route Package VI, particularly in the Hanoi and Haiphong areas, were increased in 1967 to about 20 percent of all attack sorties.

Lines of communication have been the principal targets in the air war. Almost one-half of the ordnance delivered against North Vietnam in 1967 was against lines of communication. Slightly less than 40 percent was against non-transport military targets, and a small portion was against industrial targets.

Two-thirds of all the ordnance dropped on lines of communication in 1967 was directed against the highway system. About 25 percent was on roads and trucks; almost 30 percent on road crossings such as bridges, culverts, and causeways; and almost 15 percent on road supply handling areas. The following tabulation shows the distribution of ordnance on lines of communication during 1967, by type of targets:

	Tons			
	Route Segments and Equipment	Bridges, Culverts, and Causeways	Supply Handling Areas	Totals
Roads	28,720	34,285	16,105	79,110
Railroads	2,045	9,315	15,110	26,470
Waterways	9,710	560 a/	1,720	11,990

a. Locks, levees, and embankments are included in this category.

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Most of the ordnance on military targets in North Vietnam during 1967 was against ground forces and ground forces installations. About one-third was against military troop areas, one-third against gun emplacements, including antiaircraft artillery, one-fourth against storage and supply areas, and less than 10 percent against airfields, naval bases, radar, and SAM sites.

US losses of aircraft and personnel have been substantial, but aircraft losses have not increased as rapidly as the scale of operations, see the table. A total of 823 fixed wing aircraft and ten helicopters have been lost in combat action over North Vietnam from 1965 through March 1968, and about 1,200 personnel have been reported downed with their aircraft. Aircraft losses have been declining, however, in proportion to the total number of sorties over the past three years.

Attacks against industrial and other targets in heavily defended areas, particularly in Route Package VI which contains Hanoi and Haiphong, have had the highest combat loss rates. Attacks against industrial targets suffered loss rates of 21.4 aircraft per 1,000 attack sorties in 1967, and a loss rate of 17.9 per 1,000 attack sorties was sustained in attacks against targets within 10 nautical miles of Hanoi and Haiphong during the last three quarters of 1967. By comparison, the average for all targets in 1967 was 2.4 aircraft per 1,000 sorties, and losses for attacks against lines of communication were only 2.1 per 1,000 attack sorties.

The cost to the United States of Rolling Thunder air operations has gone up each year with the increasing intensity of the air campaigns. The production cost of aircraft lost, the direct operational cost of sorties flown, and costs of ordnance delivered during 1966, 1967, and the first quarter of 1968 are shown in the following tabulation:

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Sorties, Losses, and Loss Rates of US Fixed Wing Aircraft over North Vietnam 1965-67 and January-March 1968

		Sorties [a]	Losses	Combat Losses per 1,000 Sorties
Combat losses				
Attack missions	1965	25,270	129	5.1
	1966	81,360	226	2.8
	1967	106,940	252	2.4
	Jan-Mar 1968	14,800	31	2.1
Total		228,370	638	
Support missions	1965	29,570	39	1.3
	1966	65,660	57	0.9
	1967	84,180	76	0.9
	Jan-Mar 1968	20,430	13	0.6
Total		199,840	185	
All missions	1965	54,840	168	3.1
	1966	147,020	283	1.9
	1967	191,120	328	1.7
	Jan-Mar 1968	35,230	44	1.2
Total		428,210	823	
Combat and operational losses				
All missions	1965	54,840	185	3.4
	1966	147,020	316	2.1
	1967	191,120	366	1.9
	Jan-Mar 1968	35,230	54	1.5
Total		428,210	921	

a. Attack sorties carry out strike and flak-suppression missions. Support sorties make up the remainder, which conduct photo and electronic reconnaissance, combat air patrol, search and rescue, electronic countermeasure, refueling, and forward air control missions.

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	Million US $		
	1966	1967	Jan-Mar 1968
Production Cost	605.6	739.0	125.9
Operational Cost of Sorties Flown	330.4	451.2	79.1
Ordnance	311.5	479.2	70.6 a/
Total	*1,247.5*	*1,669.4*	*275.6*

a. Cost of ordnance is estimated for 1968.

In addition to direct costs, there are substantial indirect but unmeasurable costs associated with the bombing.

The direct cost to the United States of inflicting one dollar's worth of damage on North Vietnam declined from $10.98 in 1966 to $7.07 in 1967, but the possibilities of a continued decline are limited as the number of significant economic targets decreases. During the first quarter of 1968, for example, cost of damage inflicted was estimated to be $18.0 million and direct operational costs were estimated to be $275.6 million, an average cost of $15.30 for each dollar's worth of damage inflicted.

II. Effects of the Rolling Thunder Program

A. Value of Damage

The value of measurable damage inflicted on the North Vietnamese by the Rolling Thunder campaign reached $436 million through March 1968. Economic damage reached about $300 million through March 1968, of which about $158 million was inflicted in 1967. Attacks against North Vietnam's military establishment -- SAM's, aircraft, radars, barracks, supply depots, airfields, naval equipment, and the like -- have inflicted additional damage estimated at about

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$136 million since the start of the bombing. In addition, North Vietnam has incurred other significant but unmeasurable losses from the bombing. An estimated 500,000 to 600,000 civilian workers were diverted to full-time and part-time repair and defense work related to the bombing. The lot of the average citizen became more trying; families have been separated, some cities have been partly evacuated, and loss of life and property has been substantial. Large quantities of military and economic aid, however -- $1 billion in 1967 alone -- more than offset the cost of damage inflicted by air attacks.

B. Transportation

The rail system has been extensively damaged, but it continues to move a substantial volume of supplies. Attacks against the rail lines have been heaviest on the Hanoi-Vinh line south of Hanoi, and through rail service from Hanoi to Vinh has been effectively halted during much of the air campaign. In mid-June 1967, railroad targets on the Dong Dang and Lao Cai lines in the north and in previously restricted areas of Hanoi, Haiphong, and the buffer zone along the Chinese border were brought under repeated and heavy attack. Key bridges in Hanoi and Haiphong were interdicted for varying periods, hindering through rail service in and out of Hanoi and the port of Haiphong. The Doumer Bridge over the Red River has been out of service for rail traffic about 80 percent of the time since August 1967, and continuously since being extensively damaged by air strikes in mid-December. The Hanoi Railroad/Highway Bridge over the Canal des Rapides near Hanoi has been out of use almost 40 percent of the time since late April 1967. The Haiphong Railroad/Highway Bridge was out of service continuously from 28 September 1967 to April 1968. However, rail service on the Dong Dang line -- the primary overland import route from Communist China -- to the Canal des Rapides Bridge near Hanoi has continued almost without interruption. Elsewhere, at least shuttle service between interdicted points has been maintained and most interdicted rail bridges have been bypassed by multiple ferry and pontoon crossings.

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Despite the Rolling Thunder campaign, the capacity and flexibilities of the rail system have been increased by new construction and improvements -- much of it by Chinese construction units. The Dong Dang line from Ping-h'siang to Kep, and the Thai Nguyen to Yen Vien line, have been converted to dual gauge;* together with a standard gauge route from Kep to Thai Nguyen, these lines provide a standard gauge route from the China border to the Hanoi area with a capacity almost double that of a meter gauge system. Portions of the Hanoi-Dong Dang line south of Kep to Yen Vien are now being converted from meter gauge to dual gauge. In addition, a new rail line is under construction from Kep east to Hon Gai, a secondary port and coal producing area.

The highway system has not been seriously disrupted by the Rolling Thunder program, although the system has been heavily attacked. Most of the airstrikes against highways have been concentrated south of Thanh Hoa along Routes 1A and 15 and against key bridges in the Hanoi and Haiphong areas. Intensive armed reconnaissance strikes have also been maintained against routes leading into the DMZ and Laos. An increased volume of truck traffic has been noted in recent months, however, and substitutes for damaged highway bridges in Hanoi, Haiphong, and elsewhere are less vulnerable and have capacities higher than the roads which they support.

Despite the Rolling Thunder program, the highway system has been continuously improved and expanded, with construction in the north aided by Chinese road construction units. In the northeast, a new all-weather road linking the Ning-ming area of China with Haiphong is near completion and will increase the transborder road capacity to this major Chinese logistic center. In the Panhandle of North Vietnam, Route 101, a major north-south inland alternate to Route 1A, and Route 137, a second major route for infiltration into Laos, have been

** The term "dual-gauge" refers to the use of three or four rails on the same roadbed, making possible the use of both meter gauge and standard gauge rolling stock. It is not to be confused with "double tracking" -- two separate tracks on two or double road beds with a total of four rails.*

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completed. A new all-weather road, a third major Laotian infiltration route, is under construction from the vicinity of Dong Hoi toward the southwestern corner of the DMZ. A number of bypass and connecting roads have also been built and many old roads improved. In the northwest, construction and improvement of roads will provide a more direct motorable link between China and northern Laos through North Vietnam.

Inland waterways have not been seriously disrupted by air attacks. The main attacks against inland water transportation have consisted of armed reconnaissance strikes against watercraft and waterway facilities, including transshipment points. In addition, from June 1967 through April 1968, 26,000 MK-36 mines were seeded to harass watercraft and disrupt waterway operations. However, a substantial volume of traffic continues to move over inland waterways, and the North Vietnamese have demonstrated the ability to use mined areas soon after seedings.

Transport equipment has been destroyed and damaged in large quantities, but increased imports and domestic repair and construction have maintained or improved equipment inventories. Pilots have reported the destruction and damage of large numbers of railroad rolling stock, motor vehicles, and watercraft in North Vietnam, and reports of truck destruction increased significantly in early 1968. However, inventories of railroad rolling stock and trucks have actually been increased above the prebombing levels by imports from North Vietnam's allies. Domestic construction of boats and imports of barges and prefabricated barge sections probably have compensated for most of the watercraft losses.

C. Other Economic Target Systems

North Vietnam's modern industries have been either inoperative or operating at partial capacity since the initiation of intensive attacks on industrial targets in early 1967. Electric generating capacity was reduced by bombing to 20 percent of the prestrike capacity of 187,000 kilowatts from June through October 1967. However, the respite from bombing since November 1967 has permitted electric generating capacity to be restored to 30 or 40 percent of prebombing capacity. If the bombing pause continues, output of electric power could

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increase to about 60 percent of capacity in about six months. The Thai Nguyen Iron and Steel Plant has been inoperative since being heavily damaged in mid-April 1967. The Haiphong Cement Plant was inoperative for one year until late April 1968, when repairs apparently permitted a test run on at least one kiln. Bomb damage also halted production at the Bac Giang Chemical Fertilizer Plant, the Phu Tho Phosphate Fertilizer Plant, the Lang Chi Explosives Plant, the Viet Tri Paper Plant, and portions of the Hon Gai and Cam Pha coal-processing facilities. In addition, the Viet Tri Chemical Complex was inoperative for a large part of the year as a result of a shortage of electric power. Repairs, however, have permitted at least some production to resume at the Phu Tho Fertilizer Plant, the Viet Tri Chemical Complex, and the coal facilities at Hon Gai and Cam Pha. The direct cost of restoring industry damaged by bombing totals more than $50 million, and reconstruction would require up to two years to complete.

The machine building industry has been relatively undamaged by US airstrikes. Small repair shops and foundries are widely dispersed throughout the country, and the three plants in Hanoi and Haiphong that account for the principal output of machinery and machine tools are within restricted bombing zones. The products and services of this industry are oriented primarily toward support of transportation and of agriculture. In its support of transportation, machine building comes closer than any other domestic industry to direct support of the war in the south. Capacity for machine building and metal processing probably has been enlarged since the beginning of the air war through substantial imports of machinery and equipment. Most imports of machine tools during 1966 were appropriate for repair work and probably were intended for the dispersed repair shops. However, during 1967 a large portion of imports were high-output machine tools, suggesting that the three central machine building plants are engaged in production of significant quantities of agricultural pumps, generators, and diesel engines.

Most of North Vietnam's petroleum storage facilities that existed before the bombing have been destroyed. Use of dispersed tank sites and

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petroleum drums, however, has reestablished satisfactory supply and distribution of petroleum products and has enabled the North Vietnamese to maintain a three-month reserve supply of petroleum.

D. Other Economic Losses

The cumulative measurable loss in North Vietnam's seaborne exports attributable to the Rolling Thunder program reached about $35 million at the end of 1967, but these losses have had little adverse effect on the economy. Measurable export losses represented less than 20 percent of the value of North Vietnam's annual exports before the initiation of the bombing program and were small compared with the estimated $340 million of economic aid contributed by the Communist countries in 1967 alone. Stepped-up attacks on industrial facilities during the first half of 1967 accounted for almost one-half of the cumulative export losses. Exports of pig iron and cement have not been observed since May 1967, and exports of coal, which averaged about 78,000 tons per month in 1966, were reduced to only 21,000 tons per month in the second half of 1967.

Agriculture and fishing have been adversely affected by bombing, although neither has ever been targeted nor suffered more than minor accidental bomb damage. The decline in rice output since the beginning of the bombing -- only partly attributable to the air campaign -- has been valued at about $60 million. The agricultural labor force, about 70 percent of the total labor force, has been the main source of manpower for defense and construction work generated by the bombing program. The low per capita productivity of agricultural workers, the unskilled nature of the work, the high agricultural underemployment, and the ready substitutability of women for men undoubtedly mitigated the effects on agriculture of the diversion. The Rolling Thunder program has also contributed, in conjunction with the Sea Dragon Program, to a decline in salt water fishing estimated to be valued at $12.5 million. Despite reduced rice and fish production, however, minimum diets have been maintained by strict rationing, by substituting less palatable foods, and, in 1967, by greatly increasing imports of foodstuffs.

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D. Military Targets

The most significant damage inflicted by the Rolling Thunder program on the North Vietnamese military establishment has been against the air defense system, particularly against aircraft. Cumulative destruction of fighter aircraft through the first quarter of 1968 amounted to 32 MIG-21's and 87 MIG-17's. All major airfields except that at Gia Lam, an international commercial airport as well as a military airfield, have been struck repeatedly. Attacks against airfields have forced the deployment of most of the inventory of about 23 MIG-21's and 114 MIG-17's to airfields in southwest China. Numerous early warning and ground-control intercept radars, antiaircraft artillery, and SAM facilities and equipment have been destroyed or damaged, and airstrikes have probably reduced the efficiency of SAM units by forcing frequent redeployment of equipment.

However, countermeasures, imports of equipment, and rapid repair work have offset the damage inflicted to the air defense system. Replacement of MIG-21's from the USSR and MIG-17's from China have been sufficient to maintain North Vietnam's MIG inventory at a relatively constant level. A small effective force of 25 MIG's continues to stage out of North Vietnamese airfields, and the capability of this force has improved. MIG-21 operations have expanded from defensive patrols around the Hanoi and Haiphong areas to areas as far south as Vinh and over the border into Laos. Damage to airfields has been quickly repaired, and all primary jet airfields were capable of supporting fighter operations at the end of March. The North Vietnamese radar system has become increasingly formidable and sophisticated. The proficiency of operating personnel has improved with experience and training, and China has recently provided the North Vietnamese with its version of the Soviet Fan Song, one of China's most modern radars. At the end of March 1968, North Vietnam had at least 225 radars at 71 sites, compared with 149 radars at 50 sites at the end of 1966. During the past year the North Vietnamese have also maintained an inventory of at least 6,000 antiaircraft artillery pieces of 37-mm or larger and SAM defenses of about 30 active battalions; nearly 200 prepared or pre-surveyed SAM sites are available for use, including six or seven in the vicinity of the DMZ.

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Valuable military supplies, equipment, storage facilities, barracks, and ordnance depots have also been destroyed or abandoned because of air attacks, but the loss of these supplies and facilities has not seriously impaired the overall effectiveness of North Vietnam's military capabilities. Imports of supplies and equipment from the USSR and China have exceeded destruction at depots, and the North Vietnamese have adequately adjusted to the loss of fixed facilities by the dispersal of men and supplies. The North Vietnamese have had no serious difficulty in supporting increased military activity in South Vietnam.

Nearly one-third of North Vietnam's naval base support facilities have been destroyed or rendered inactive, and 12 naval craft have been destroyed by air attacks under the Rolling Thunder program. However, the small North Vietnamese navy -- about 40 patrol boats, gunboats, torpedo boats, and subchasers -- has played a relatively minor part in the war effort, and it has been largely confined to the Hanoi and Haiphong areas to bolster the air defense system.

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